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Flukes of birds of Drużno Lake

[Parasitofauna of the biocoenosis of Drużno Lake — part III]

Przywry ptaków jeziora Drużno

[Parazytofauna biocenozy jeziora Drużno — część III]

The object of this work were the flukes of birds of the biocoenosis of Drużno Lake in 1950, 1951 and 1953. A description of the whole of the material of hosts, parasites and methods of collecting the materials is to be found in the study by Prof. Dr W. L. Wiśniewski (36, 37). The object of this paper was to establish the qualitative and quantitative composition of flukes of the avifauna of Drużno Lake and to discuss problems directly connected with the occurrence of flukes in birds.

I wish to express my appreciation to Professor Dr W. L. Wiśniewski for the offering of the material and for the help by my studies.

Methods of research

Most birds were examined as soon as they were caught. Flukes were looked for in the following organs: eye-balls, trachea, lungs, alimentary tract, liver, gall-bladder, bursa Fabricii, kidneys, milt, heart, and body-cavity. The flukes found were classified according to their species, counted, and preserved in 75% alcohol.

The whole of the research aimed at finding out what were the dominant species of bird flukes in the Drużno biocoenosis, and consequently efforts were made to examine the birds in the proportion of their occurrence in nature.

Materials

The materials come from 285 birds of which 102 (36%) were examined in 1950 and 183 (64%) in 1951. A total of 45 bird species were examined, all of them being more or less closely connected with Drużno Lake. Table I shows a list of the birds examined and the degree of their invasion.

In accordance with the above stated principle of examining the birds in the proportion of their occurrence in nature representatives of the families *Anatidae, Laridae,* and *Podicipedidae* were examined first of all. Of the families poorly represented in the avifauna of the lake only single specimens were examined. It follows from Table I that the invasion of the birds is high on the whole. Birds connected with the lake through their food were invaded in 20 to 100%. The scale of intensity does not coincide with that of extensity. The relatively highest extensity of invasion was found in *Anatidae, Laridae, Podicipedidae,* and *Ardeidae*; it was lower in *Rallidae, Scolopacidae, Phalacrocoracidae,* and *Accipitridae. Anas platyrhynchos* (96%) proved to be the host showing the greatest intensity of invasion in the avifauna of Drużno Lake. The greatest number of fluke species (9) was found in *Aythya nyroca.* The latter ranks among the bird species typical of the biocoenosis but it occurs less frequently than *Anas platyrhynchos, Fulica atra, Larus ridibundus* and *Sterna hirundo. Anas platyrhynchos* (8 fluke species) and *Aythya ferina* (6 fluke species) also contained many fluke species.

Table I

List of birds examined at Drużno Lake and degree of their invasion

No.	Syst. group	Species of birds	1950		1951		together	
			exam.	invad.	exam.	invad.	exam.	invad.
1.	*Anatidae*	*Anas crecca*	3	2	—	—	3	2
2.		*Anas platyrhynchos*	24	23	14	14	38	37
3.		*Anas strepera*	2	2	—	—	2	2
4.		*Anas querquedula*	3	2	1	1	4	3
5.		*Aythya ferina*	4	3	—	—	4	3
6.		*Aythya fuligula*	2	2	—	—	2	2
7.		*Aythya nyroca*	10	8	12	8	22	16
8.		*Mergus albellus*	3	2	1	1	4	3

Table I — continued

No.	Syst. group	Species of birds	1950		1951		together	
			exam.	invad.	exam.	invad.	exam.	invad.
9.	*Laridae*	*Chlidonias nigra*	3	2	14	3	17	5
10.		*Larus canus*	—	—	3	1	3	1
11.		*Larus ridibundus*	7	3	31	27	38	30
12.		*Sterna hirundo*	2	—	12	—	14	—
13.	*Rallidae*	*Fulica atra*	29	5	25	6	54	11
14.		*Gallinula chloropus*	1	—	4	1	5	1
15.		*Porzana parva*	—	—	2	—	2	—
16.		*Porzana porzana*	—	—	1	1	1	1
17.		*Rallus aquaticus*	—	—	2	1	2	1
18.	*Podicipedidae*	*Podiceps cristatus*	5	4	11	8	16	12
19.		*Podiceps griseigena*	—	—	1	1	1	1
20.	*Scolopacidae*	*Clidris alpina*	—	—	1	—	1	—
21.		*Calidris minuta*	—	—	1	—	1	—
22.		*Capella gallinago*	—	—	2	1	2	1
23.		*Tringa erythropus*	—	—	1	—	1	—
24.		*Tringa glareola*	—	—	7	—	7	—
25.		*Philomachus pugnax*	2	—	3	2	5	2
26.	*Ardeidae*	*Ardea cinerea*	—	—	3	1	3	1
27.		*Botaurus stellaris*	1	1	—	—	1	1
28.		*Ixobrychus minutus*	1	1	1	1	2	2
29.	*Accipitridae*	*Circus aeruginosus*	—	—	3	2	3	2
30.		*Circus pygargus*	—	—	1	—	1	—
31.		*Milvus milvus*	—	—	1	—	1	—
32.		*Phalacrocorax carbo*	—	—	1	1	1	1
33.	*Passeriformes*	*Chlorospiza chloris*	—	—	1	—	1	—
34.		*Corvus cornix*	—	—	1	—	1	—
35.		*Emberiza citrinella*	—	—	1	—	1	—
36.		*Hirundo rustica*	—	—	4	2	4	2
37.		*Motacilla alba*	—	—	5	—	5	—
38.		*Parus coeruleus*	—	—	1	—	1	—
39.		*Parus major*	—	—	1	—	1	—
40.		*Panurus biarmicus*	—	—	2	—	2	—
41.		*Phylloscopus collybita*	—	—	1	—	1	—
42.		*Phylloscopus trochilus*	—	—	1	—	1	—
43.		*Riparia riparia*	—	—	2	—	2	—
44.		*Sturnus vulgaris*	—	—	2	—	2	—
45.		*Alcedo atthis*	—	—	1	—	1	—
		Total	102	60	183	83	285	143

The highest intensity of invasion was observed in *Laridae* and *Anatidae*, *Larus ridibundus* being the host showing the highest intensity of invasion. *Anas platyrhynchos*, the most common of ducks, ranks third in the intensity of invasion (1 175 flukes) after *Larus ridibundus* (5 441 flukes) and *Aythya nyroca* (2 012 flukes).

Special attention should be paid to *Fulica atra*, which has a poor fauna of flukes at Drużno. It is the most common bird species in the biocoenosis and shows a high degree of extensity and intensity of invasion in relation to tapeworms and a low one in relation to flukes. In the sixty specimens of *Fulica atra* examined within three years 140 fluke specimens representing only three fluke species were found, which in comparison with other birds shifts this species to one of the last positions among birds as hosts of flukes in the Drużno biocoenosis.

Table II

The occurrence of flukes in bird families

Bird families	Number of birds examined	Number of birds invaded	Number of fluke species	Number of fluke specimens
Anatidae	79	68	14	3 812
Laridae	72	36	7	5 578
Podicipedidae	17	13	4	954
Rallidae	64	14	6	150
Ardeidae	6	4	6	43
Scolopacidae	17	3	4	77
Accipitridae	5	2	2	10
Phalacrocoracidae	1	1	1	17
Hirundinidae	4	2	1	23

Birds families as hosts of flukes

14 fluke species represented by 3 812 specimens were observed in eight species of *Anatidae*, which shifts *Anatidae* to the first place as fluke hosts among birds. This coincides with their position in the avifauna of the lake, since as regards specific differentiation and number *Anatidae* occupy the first place among the Drużno birds. Of the fourteen fluke species eight were found in the intestine, one in the caeca, one in the bursa Fabricii, one in the kidneys, two in the trachea, and one in the blood vessels of the intestine and the liver.

Laridae occupy the second place, which also coincides with their position in the avifauna. Seven fluke species, six in the intestine and one in the kidneys, were found in *Laridae.*

Species of ibrds of the families *Podicipedidae, Rallidae* and *Ardeidae* are also important hosts of flukes. Three fluke species were observed in the intestine and one in the blood vessels of the liver and the intestines in *Podicipedidae;* two species were found in the intestine, one in the caeca, two in the trachea, and one in the blood vessels of the liver and the kidneys in *Rallidae*; five species occurred in the intestine, and one in the blood vessels of the liver in *Ardeidae.*

The other four bird families play no major part in the mass spreading of flukes in the biocoenosis of Drużno Lake. Only single intestinal species of flukes were found in them.

The occurrence of flukes in their hosts

The invasion of birds by various fluke species shows a varying scale of intensity. There are species which occurred frequently, almost in every specimen of a given host and this were defined as typical of the biocoenosis. Yet, on the other hand, there are species found in a small proportion of hosts and in small quantities; these are non-typical or accidental in the biocoenosis. As regards the intensity of occurrence of various fluke species in the biocoenosis, a scale ranging from a few to a few thousands of specimens may be established.

The occurrence of various fluke species in their corresponding hosts is shown in Table III.

Anas platyrhynchos (Linn.)

It is a bird typical of the Drużno biocoenosis. In 1950 and 1951 38 specimens were examined of which 37 (97%) were invaded. Eight fluke species were found in them.

Hypoderaeum conoideum (Bloch, 1782).

A common parasite of the *A. platyrhynchos* intestine. Mature specimens occurred in summer and autumn together with immature ones, the intensity of invasion amounting to 1 to 25. Many authors stated this species in many duck species in various parts of the world. A species typical of the Drużno biocoenosis; it parasitizes only *A. platyrhynchos* and *Aythya nyroca* at Drużno.

Table

The occurrence of

Host \ Fluke species	*Apatemon gracilis*	*Apharyngostrigea cornu*	*Codonocephalus urnigerus*	*Cotylurus cornutus*	*Cotylurus pileatus*	*Cyathocotyloides* sp.	*Diplostomum mergi*	*Diplostomum spathaceum*	*Posthodipl. brevicaudatum*	*Ophiosoma patagiatum*	*Strigea falconis*	*Tylodelphys clavata*	*Tylodelphys contfera*	*Echinochasmus coaxatus*	*Echinoparyph. recurvatum*	*Echinostoma revolutum*	*Echinostoma stantschynskii*
Anas crecca																	
Anas platyrhynchos															○	●	
Anas strepera	●																
Anas querquedula																	
Aythya ferina				○		○										●	
Aythya nyroca	●														○	●	
Aythya fuligula																●	
Mergus albellus	●						○										
Chlidonias nigra					●												
Larus canus								●									
Larus ridibundus								●									
Podiceps griseigena														●			
Podiceps cristatus													○	●			
Fulica atra																	
Gallinula chloropus																	
Porzana porzana																	
Rallus aquaticus																	
Ardea cinerea		○															
Botaurus stellaris			○							○							
Ixobrychus minutus									●								
Capella gallinago																	○
Philomachus pugnax																	
Circus aeruginosus											○	○					
Phalacrocorax carbo																	
Hirundo rustica																	

● species typical of the biocoenosis
○ species non-typical of the biocoenosis

III

fluke species in hosts

| | | |

Table IV

Fluke species found in *Anas platyrhynchos*

Fluke species	Localization	Number of birds invaded	Number of flukes
Hypoderaeum conoideum	intestine	18	199
Echinostoma revolutum	intestine	7	21
Echinoparyphium recurvatum	intestine	3	179
Psilochasmus oxyurus	intestine	4	17
Notocotylus attenuatus	caeca	13	380
Tracheophilus sisowi	trachea	1	1
Eucotyle zakharowi	kidneys	1	6
Bilharziella polonica	blood vessels of liver α int.	20	372
			Total 1175

Echinostoma revolutum (Frölich, 1802).

In *A. platyrhynchos* the intensity of invasion varies from one to three. Besides it has another three hosts among ducks at Drużno. Yet it occurs seldom and in small numbers. It seems to be a species of a very wide specificity and, consequently, of a great range of occurrence.

Echinoparyphium recurvatum (Linstow, 1873).

A. platyrhynchos is its additory host in the Drużno biocoenosis, although the intensity of invasion varies greatly (3-170). Recorded repeatedly in Western Europe and the USSR, typical of ducks first of all. Mature specimens were found in summer and autumn.

Psilochasmus axyurus (Creplin, 1825).

Common throughout Europe according to Skrjabin, scanty at Drużno Lake.

Notocotylus attenuatus (Rudolphi, 1809).

Occurs heavily in *A. platyrhynchos*. There were 5 to 130 flukes in one bird on the average. Common in ducks first of all according to Skrjabin & Bychovska-Pavlovska, found also in *Scolopacidae*. A cosmopolitan species.

Tracheophilus sisowi Skrjabin, 1913.

Only once found at Drużno. A species typical of ducks according to Skrjabin, as wide-spread as *Typhlocoelum cucumerinum*.

Eucotyle zakharowi Skrjabin, 1920.

Parasitizes in the *A. platyrhynchos* and *Aythya nyroca* kidneys.

Skrjabin and Bychovska-Pavlovska regard this species as typical of ducks only. Seems to be a rare species.

Bilharziella polonica (Kowalewski, 1895).

One of the most frequent and numerous parasites of *A. platyrchynchos*. The intensity of invasion amounted to 5 to 32 specimens, always male. A very common species in Poland. As regards the number of hosts it occupies the first place among the flukes at Drużno. It was discovered in eight bird species of three unrelated families (*Anas platyrhynchos, Anas crecca, Anas querquedula, Aythya ferina, Aythya nyroca, Podiceps cristatus, Podiceps griseigena, Ardea cinerea*).

Anas crecca (Linn.)

A bird rare at, and only seasonally coming to, Drużno Lake. Three specimens were examined in 1950. In the liver of one of them there were ten males of *Bilharziella polonica*, and in the caeca of another one 1 specimen of *Notocotylus attenuatus*.

Anas strepera (Linn.)

Although scantily represented at, always connected with, Drużno Lake. Two birds examined in 1950. 87 specimens of *Apatemon gracilis* (Rudolphi, 1819), Szidat, 1928 were found in both. It follows from Dubois' findings that this species had not been observed in this host before, although it is common in many parts of the world.

Anas querquedula (Linn.)

Ranks among fairly common birds at Drużno. Four specimens of *A. querquedula* were examined in 1950 and 1951. The presence of 14 *Bilharziella polonica* males was observed in three of them. There were five specimens in one host on the average.

Aythya ferina (Linn.)

A duck species ranked among those typical of the Drużno avifauna. Four specimens, of which three were invaded, were examined in summer 1950. All fluke species listed in the table below were discovered in one *A. ferina*, while only *Bilharziella polonica* males were found in the other two.

Table V
Fluke species found in *Aythya ferina*

Fluke species	Localization	Number of brids invaded	Number of flukes
Cyathocotyloides sp.	intestine	1	19
Echinostoma revolutum	intestine	1	11
Hypoderaeum conoideum	intestine	1	15
Cotylurus cornutus	intestine	1	8
Notocotylus attenuatus	caeca	1	1
Bilharziella polonica	blood vessels of liver	3	36
			Total 90

Cotylurus cornutus (Rudolphi, 1808), Szidat, 1928.

According to Dubois this is a species very common in *Charadriidae* and *Anatidae*, its range of appearance being wide. Only one mature form was found at Drużno, while larvae (cercariae and metacercariae) are common in the biocoenosis (Wiśniewski).

Aythya fuligula (Linn.)

Ranks among birds typical of Drużno Lake. Two birds were examined in September and November 1950. Nine *Echinostoma revolutum* were found in them, while one specimen of *Typholocoelum cucumerinum* (Rudolphi, 1809), a species of a wide range of appearance, was discovered in the trachea of one of them.

Aythya nyroca (Güld.)

After *A. platyrhynchos* the second commonest duck at Drużno. 22 birds were examined in 1950 and 1951 of which 16 (73%) were invaded. *Aythya nyroca* contained most fluke species (9).

Aythya nyroca is the main host of *Echinoparyphium recurvatum*, the intensity of invasion varying from 50 to 1 720 specimens.

Prosthogonimus ovatus (Rudolphi, 1803) Lühe, 1899.

According to Lühe, Bychovska-Pavlovska and others the species is frequently recorded in various birds throughout the world, but it was scanty at Drużno.

Table VI
Fluke species found in *Aythya nyroca*

Fluke species	Localization	Number of birds invaded	Number of flukes
Apatemon gracilis	intestine	1	25
Echinostoma revolutum	intestine	1	1
Echinoparyphium recurvatum	intestine	4	1 871
Hypoderaeum conoideum	intestine	1	40
Notocotylus attenuatus	caeca	1	1
Prosthogonimus ovatus	bursa Fabricii	1	3
Eucotyle zakharowi	kidneys	1	2
Typhlocoelum cucumerinum	trachea	4	5
Bilcharziella polonica	circ. syst. of liver	9	63
			Total 2 012

Eucotyle zakharowi Skrjabin, 1920.

The fluke found does not answer Skrjabin's description as far as the size of testes and the appearance of the uterus are concerned. According to Skrjabin *Eucotyle zakharowi* possesses a well-developed uterus and large testes, the specimen found by me had a less well-developed uterus and not so large testes. I think however that these divergencies lie within the limits of variability and may be due to its stay in non-typical host.

Mergus albellus (Linn.)

M. albellus does not nest at Drużno and stays at the lake only in the period of it autumn migrations. Four birds were examined in 1950 and 1951. *Apatemon gracilis* proved to be typical intestinal species occurring in three specimens. There were 378 specimens in all. Moreover the presence of 35 *Diplostomum mergi* (Dubois, 1932) was observed in one specimen. The species has been described relatively recently. According to Dubois it is rare and known so far in Europe only.

Larus ridibundus (Linn.)

A bird typical of the Drużno biocoenosis, although it does not nest there. 38 specimens were examined in 1950 and 1951 of which 30 (79%) were invaded. A total of five fluke species were observed in them.

Table VII
Fluke species found in *Larus ridibundus*

Fluke species	Localization	Number of birds invaded	Number of flukes
Apophallus mühlingi	intestine	23	1 863
Diplostomum spathaceum	intestine	28	3 500
Mesorchis pseudoechinatus	intestine	6	35
Plagiorchis laricola	intestine	1	17
Tanaisia fedtschenkoi	kidneys	1	26
			Total 5 441

Diplostomum spathaceum (Rudolphi, 1819) Braun. 1893.

Occurs heavily in *L. ridibundus* at Drużno. All specimens were mature in spring, summer and autumn. Dubois regards this species as typical of the genus *Larus*. It is distributed throughout Europe, Africa and North America. In the Drużno avifauna its principal host is *L. ridibundus* and its additory host is *L. canus*. *Diplostomum spathaceum* is the most typical fluke in the biocoenosis of Drużno Lake.

Apophallus mühlingi (Jägerskiöld, 1899) Lühe, 1909.

Another fluke typical of *L. ridibundus* and one of the most common throughout the biocoenosis. It occurs heavily in spring, summer and autumn, its specimens being mature then. The intensity of invasion varied from 5 to 230 specimens. Skrjabin says that *Apophallus mühlingi* is parasitic mostly in *Laridae*, and besides it was found in other birds as well. It was discovered in cat in Ukraine (Prendel, 1937). Distributed in Europe and Asia. At Drużno *L. ridibundus* is its main host and *L. canus* its additory host. Occurs with *Diplostomum spathaceum*, but less frequently on the whole, the relation of the total of *Diplostomum spathaceum* to that of *Apophallus mühlingi* being 2 to 1.

Mesorchis pseudoechinatus (Olsson, 1876) Dietz, 1909.

Found at Drużno in autumn only. Ranks with the typical intestinal parasites of *Laridae*. Distributed in the USSR, Western Europe and Eastern Africa, generally occurs in single specimens.

Plagiorchis laricola Skrjabin, 1924.

Repeatedly recorded in the territory of the USSR but scanty at Drużno, it seems to be an accidental species in the biocoenosis of the lake.

Tanaisia fedtschenkoi Skrjabin, 1924.

Discoverd in one *L. ridibundus* only, which had no parasites besides. According to Skrjabin it is frequent in the USSR, typical of *Laridae* first of all, but also found in *Charadriidae*, *Rallidae* and some *Anatidae*. Of no major importance in the Drużno biocoenosis.

Larus canus (Linn.)

Because of the paucity of its representatives it constitutes a minor element in the avifauna of Drużno Lake. Three specimens were found in 1951. The presence of 32 *Diplostomum spathaceum* and 72 *Apophallus mühlingi* was observed in one specimen. Many researchers have discovered these species in *L. canus*, but since it occurs in the Drużno avifauna accidentally it plays a minor part in spreading these flukes.

Chlidonias nigra (Linn.)

Beside *Larus ridibundus* and *Sterna hirundo* this is one of the most common representatives of *Laridae* in the avifauna of Drużno Lake, and also a typical bird in the biocoenosis. Seventeen birds, of which 5 (29%) were invaded, were examined in 1950 and 1951. In the intestine of four of them 30 *Cotylurus pileatus* (Rudolphi, 1802) Dubois, 1937 were found. As stated by Dubois various birds of the family *Laridae*, including *Ch. nigra*, the most numerous of the family at Drużno, are typical hosts of *Cotylurus pileatus*. As it follows from my observations *Ch. nigra*, in which, according to Dubois, this fluke was recorded but once, is its main host at Drużno, while *C. pileatus* was not found in *L. ridibundus* and *Sterna hirundo*.

Besides three specimens of *Plagiorchis* sp. in one *Ch. nigra* were found.

Podiceps cristatus (Linn.)

A bird typical of the Drużno biocoenosis. Of the 16 birds examined in 1950 and 1951 twelve (75%) were invaded.

Echinochasmus coaxatus Dietz, 1909.

Heavily occurring at Drużno in spring, summer and autumn. All specimens were mature then. The intensity of invasion amounted to 3 to 50 flukes. Widely distributed in Western Europe and the USSR.

Table VIII
Fluke species found in *Podiceps cristatus*

Fluke species	Localization	Number of birds invaded	Number of flukes
Echinochasmus coaxatus	intestine	9	169
Monilifer spinulosus	intestine	6	493
Tylodelphys conifera	intestine	3	254
Bilharziella polonica	blood vessels of liver	3	3
			Total 919

Monilifer spinulosus (Rudolphi, 1809).

Found beside *Echinochasmus coaxatus*. The relation of the number of *Echinochasmus coaxatus* specimens to that of *Monilifer spinulosus* in one bird is 1 to 3 on the average. The intensity of invasion amounted to 7 to 240 flukes. The ranges of occurrence of *Monilifer spinulosus* and *Echinochasmus coaxatus* coincide.

Tylodelphys conifera (Mehlis, 1846) Dubois, 1937.

Discovered in 1951 only, but in a relatively great number. There were 10 to 150 flukes on the average in one *P. cristatus*. Known in Germany and Switzerland.

Considering the number of their specimens and the frequency of their occurrence, *Echinochasmus coaxatus, Monilifer spinulosus,* and *Tylodelphys conifera* ought to be regarded as typical of *P. cristatus,* while *Bilharziella polonica* is a parasite rather accidental to it.

Podiceps griseigena (Bodd.)

A rare bird at the lake. One representative was examined in 1951. Its parasitofauna does not differ from that of *P. cristatus*. There were five *Echinochasmus coaxatus* and 23 *Monilifer spinulosus* in the intestine and seven *Bilharziella polonica* males in the blood vessels of the intestines. Occurring scantily, *P. griseigena* is an additory host of these species at Drużno. Skrjabin is also inclined to regard it as an additory host.

Fulica atra (Linn.)

The most common bird at Drużno. 54 *F. atra* were examined in 1950 and 1951, of which 11 (20%) were invaded.

Table IX
Fluke species found in *Fulica atra*

Fluke species	Localization	Number of birds invaded	Number of flukes
Catatropis pacifera	caeca	9	131
Dendritobilharzia pulverulenta	blood vessels of lungs	3	7
Cyclocoelum microstomum	body cavity	1	2
			Total 140

Catatropis pacifera (Noble, 1933).

According to Skrjabin it is a species of a wide range of occurrence, and it ranks among the typical flukes of the Drużno biocoenosis. Mature specimens were found with immature ones in summer and autumn. The intensity of invasion varied from 2 to 40 specimens.

Dendritobilharzia pulverulenta (Braun, 1901) Skrjabin, 1924.

Occurs fairly frequently in the territory of the USSR, but is rare and scanty at Drużno. In Poland discovered for the first time by Ejsmont in Polesie.

Cyclocoelum microstomum (Creplin, 1829) Kossack, 1911.

Specimens one to two cm long were always found in the body cavity. They showed very much vitality, since they could live for anything up to forty hours after the bird was killed. A species typical of *Rallidae*, recorded in the USSR and Germany.

Gallinula chloropus (Linn.)

Rather scanty at Drużno Lake. Five *G. chloropus* were examined in 1950 and 1951, of which one had three specimens of *Cyclocoelum mutabile* (Zeder, 1800) in the trachea. A species of a very wide range of occurrence, but rare at Drużno.

Porzana porzana (Linn.)

Only one specimen was examined in 1951. Six specimens of *Echinostoma* sp. were found in the intestine, but they could not be identified more accurately as they had no spines.

Rallus aquaticus (Linn.)

Also typical of the biocoenosis. Two *R. aquaticus* were examined in 1951. One of them had only one specimen of *Echinostoma* sp. in the intestine. It could not be defined any more accurately as it had no spines either.

Ardea cinerea (Linn.)

Relatively fairly numerous in the Drużno avifauna. Three *A. cinerea* were examined in 1951. In the intestine of one of them five *Apharyngostrigea cornu* (Zeder, 1800) Ciurea, 1927, and in its liver a *Bilharziella polonica* male were found. *A. cinerea* seems to be an additory host of the latter.

Botaurus stellaris (Linn.)

A bird rare at Drużno. One specimen of *B. stellaris* was examined in 1950. Seven specimens of *Ophiosoma patagiatum* (Creplin, 1846) Dubois, 1937, a fluke typical of the bird, and 17 of *Codonocephalus urnigerus* Ginecinskaja, 1949 were found in the intestine. The development cycle of *Codonocephalus urnigerus* was described by Ginecinskaja; *Ixobrychus minutus* proved to be its test host. A mature form of *Codonocephalus urnigerus* was found for the first time, while its metacercaria was found by many researchers in frogs in Poland, Germany and the USSR.

Ixobrychus minutus (Linn.)

Numerous at Drużno Lake. Two birds were examined in 1950 and 1951. In the intestine of one of them the presence of two *Sodalis spatulatus* (Rudolphi, 1819), a fluke typical of *Ixobrychus minutus*, was stated and so was the presence of *Posthodiplostomum brevicaudatum* (Nordm.) Kozicka in the intestine of the other.

Capella gallinago (Linn.)

Was ranked with rare species as it stays at Drużno Lake periodically only. Two specimens were examined in 1951. Forty *Echinostoma stantschynskii* Semenov, 1927 were present in the intestine of one of them. The species has been described in Byelorussia comparatively recently; recorded in the USSR and Japan.

Philomachus pugnax (Linn.)

Not very numerous at Drużno, but always stays there. Five *Ph. pugnax* were examined in 1950 and 1951, two of them being invaded. Fourteen *Leucochloridium actitis* Mc Int., 1932 and twenty-two *Plagiorchis nanus* (Rudolphi, 1802) were found in the intestine of one of them, and one fluke, which it was possible to assign only to the genus *Echinostoma,* in the intestine of another.

Circus aeruginosus (Linn.)

Without occurring in a great number at Drużno it was ranked among birds typical of the avifauna. Three *C. aeruginosus* were examined in 1951. One of them had four *Strigea falconis* (Szidat, 1928) and another had six *Tylodelphys clavata* (Nordmann, 1832) Diesing, 1850 in the intestine.

Phalacrocorax carbo (Linn.)

A bird not typical in the Drużno avifauna. One *Ph. carbo* was examined in 1951 and 17 *Paryphostomum radiatum* (Dujardin, 1845) were found in its intestine. Skrjabin maintains that the species is typical only of *Phalacrocorax carbo* and *Ph. gracilis,* recorded in Western Europe and the USSR.

Hirundo rustica (Linn.)

Numerous on the bank of Drużno Lake. Four *H. rustica* were examined in 1951 and in two of them 23 *Plagiorchis maculosus* (Rud., 1802) were found.

The characterisation of the fluke fauna of birds of Drużno Lake

The above detailed analysis of the occurrence of flukes in various host species allows some facts to be established which are essential to the parasitocoenosis of Drużno Lake.

1. Of the 70 bird species constituting the avifauna of Drużno Lake 45 were examined in 1950 and 1951. The greater part of them (25), including almost all of those typical of the biocoenosis of the lake, were invaded by flukes. No flukes were found in *Sterna hirundo, Tringa glareola, Motacilla alba, Sturnus vulgaris,* and in another 12 species of *Charadriiformes* and *Passeriformes.*

2 A total of 43 fluke species of 11 families were recorded. *Strigeidae* (13 species) and *Echinostomidae* (12 species) were numerous, *Plagiorchidae* (4 species), *Cyclocoelidae* (4 species), *Eucotylidae* (2 species) and *Notocotylidae* (2 species) less numerous, while only single species were found of other families.

A detailed analysis of the material collected allows the question to be answered which fluke species are typical or non-typical of the biocoenosis of Drużno Lake.

In order to determine the typical fluke species the following factors were taken into consideration:

a. The frequency of occurrence (the percentage of invasion by a given fluke species) in all identified hosts of the avifauna of Drużno Lake;

b. The occurrence in the seasons of the year;

c. The total of specimens of a given fluke species found in all identified hosts of the avifauna of Drużno Lake.

As typical were recognised the species which a — were parasitic in at least ten per cent of specimens of possible final hosts in the

Table X

Species typical of the Drużno Lake biocoenosis

No.	Fluke species	Year of occurrence	No. of hosts examined	% of invasion	No. of fluke specimens	No.of hosts species
1.	*Diplopostomum spathaceum*	1950—1951	41	71	3 532	2
2.	*Apophallus mühlingi*	1950—1951	41	59	1 935	2
3.	*Echinochasmus coaxatus*	1950—1951	17	59	174	2
4.	*Bilharziella polonica*	1950—1951	92	45	506	8
5.	*Monilifer spinolosus*	1950—1951	17	35	516	2
6.	*Notocotylus attenuatus*	1950—1951	38	34	383	3
7.	*Hypoderaeum conoideum*	1950—1951	65	31	250	3
8.	*Cotylurus pileatus*	1950—1951	17	23	30	1
9.	*Apatemon gracilis*	1950—1651	28	21	490	3
10.	*Typhlocoelum cucumerinum*	1950—1951	24	21	6	2
11.	*Catatropis pacifera*	1950—1951	54	17	131	1
12.	*Mesorchis pseudoechinostomum*	1950—1951	38	16	35	1
13.	*Echinostoma revolutum*	1950—1951	67	16	46	4
14.	*Posthodiplostomum brevicaudatum*	1951	2	50	11	1

Table XI
Species non-typical of Drużno Lake biocoenosis

No.	Fluke species	Year of occurrence	No. of hosts examined	No. of hosts invaded	No. of specimens	No.of hosts species
1.	*Echinoparyphium recurvatum*	1950—1951	61	7	2 050	2*
2.	*Tylodelphys conifera*	1951	16	3	254	1**
3.	*Psilochasmus oxyurus*	1950—1951	38	4	17	1
4.	*Echinostoma stantschynskii*	1951	2	1	40	1
5.	*Diplostomum mergi*	1951	4	1	35	1
6.	*Tanaisia fedtschenkoi*	1951	38	1	26	1
7.	*Plagiorchis maculosus*	1951	4	2	23	1
8.	*Plagiorchis nanus*	1951	5	1	22	1
9.	*Cyathocotyloides* sp.	1950	4	1	19	1
10.	*Paryphostomum radiatum*	1951	1	1	17	1
11.	*Codonocephalus urnigerus*	1950	1	1	17	1
12.	*Plagiorchis laricola*	1951	38	1	17	1
13.	*Leucochloridium actitis*	1951	5	1	14	1
14.	*Cotylurus cornutus*	1950	4	1	8	1
15.	*Eucotyle zakharowi*	1950—1951	25	2	8	2
16.	*Ophiosoma patagiatum*	1950—	1	1	7	1
17.	*Dendritobilharzia pulverulenta*	1950	54	3	7	1
18.	*Tylodelphys clavata*	1951	3	1	6	1
19.	*Echinostoma* sp. 3	1951	1	1	6	1
20.	*Apharyngostrigea cornu*	1951	3	1	5	1
21.	*Strigea falconis*	1951	3	1	4	1
22.	*Tracheophilus sisowi*	1950	38	1	3	1
23.	*Cyclocoelum mutabile*	1951	5	1	3	1
24.	*Plagiorchis* sp.	1950	17	1	3	1
25.	*Prosthogonimus ovatus*	1951	22	1	3	1
26.	*Cyclocoelum microstomum*	1950	54	1	2	1
27.	*Sodalis spatulatus*	1950	2	1	2	1
28.	*Echinostoma* sp. 1	1951	5	1	1	1
29.	*Echinostoma* sp. 2	1951	2	1	1	1

* 1720 flukes were found in one *Nyroca nyroca*. As the duck was killed in September, a period of autumn migrations, it may be supposed to have come from another lake, fot the percentage of invasion by this species is low at Drużno, in spite of a great number ofr the hosts examined (61).

** *Tylodelphys conifera* appeared heavily only in 1951; it was not found in *P. cristatus* in 1950 or 1953. Consequently we consider this species as non-typical of the Drużno biocoenosis, despite the fairly large number of its representatives and the high percentage of invasion observed in 1951.

avifauna of Drużno Lake; b — were represented by a large number of specimens; c — occurred in spring, summer and autumn. Priority was given to frequent invasion and occurrence in both research years over heavy but less frequent occurrence in one research year only. For these reasons I regard e. g., *Hypoderaeum conoideum* (Table X) as more typical of the Drużno biocoenosis than *Echinoparyphium recurvatum* (Table XI) and *Catatropis pacifera* (Table X) as more typical of it than *Tylodelphys conifera* (Table XI). It is interesting to notice that in cases where the number of flukes is limited in advance by the conditions of environment, e. g., *Typhlocoelum cucumerinum* in the trachea, the frequency of appearance was taken into consideration almost exclusively.

Infrequently recorded fluke species were recognised as non-typical or accidental. In most cases a small number of hosts examined made it impossible to find more flukes of a given species. As indicated above however the number of examined specimens of the corresponding host species was proportionale to their occurrence in the Drużno biocoenosis, and consequently their parasites could not be numerous in the biocoenosis.

Two groups of flukes were established in the Drużno Lake biocoenosis: typical — of 14 fluke species, and non-typical or accidental — of 29 fluke species. The typical species are presented according to the frequency of occurrence.

It follows from Table X that the extensity of invasion does not always coincides with the intensity of invasion.

Factors regulating the occurrence of flukes in the biocoenosis

The comparatively fairly large qualitative and quantitative fluke material at my disposal allowed me to establish a few factors which account for a higher or lower invasion of birds in the biocoenosis of Drużno Lake. These are:

a. The degree of specificity of a fluke, both its mature and larval forms; a factor reflecting the mutual accommodation of the host and its parasite.

b. The quantity and quality of the food accessible to the host; a factor indicating the source of invasion.

c. The season of the year when the bird becomes invaded; a factor largely influencing the number of specimens of a given species in the biocoenosis.

Obviously the above factors are probably some of many reasons determinating the occurrence of a given fluke species in the biocoenosis, yet these became particularly clear during the research at Drużno.

Specificity

Two groups may be distinguished among the flukes appearing in the biocoenosis of Drużno Lake in respect of their occurrence in one or more species of birds. Of the 43 fluke species found in birds at Drużno 31 are connected with one bird species only, while 12 are parasitic in a few birds (Table X & XI). The specificity of the first group is not, however, literally narrow, as various research workers have found them in hosts other than those examined at Drużno. Yet in the biocoenosis of Drużno Lake their specificity is narrowed to one host only. In many instances the true reason for this seems to lie in the lack in the Drużno avifauna of a sufficient number of other hosts of these species known from literature. Thus, of the potential hosts of *Tylodelphys conifera* only *Podiceps cristatus* was represented heavily at Drużno.

The other group consists of the fluke species occurring very heavily at Drużno. Their specificity is undoubtedly wide since, as mentioned above, they parasitized several hosts.

A comparison of both fluke groups explained the great scale of differences in their quantitative occurrence in the Drużno biocoenosis. The species of a wide specificity (Table X) are represented by hundreds or even thousands of specimens, while the species of a narrow specificity occur in a few scores of specimens on the whole (Tables X & XI). A narrow specificity confines then in a high degree the number of specimens of various species in the biocoenosis.

A comparatively greater intensity of occurrence of fluke species is possible only under definite conditions:

a. when the final host occurs heavily in the biocoenosis, which makes it more likely for their eggs to be spread and for the first, intermediate hosts, which increases the number of larval forms: rasitic in *Fulica atra*, occurring very heavily at Drużno, is a good example here.

b. when there are very few final hosts and very many first and intermediate hosts, which increases the number of larval forms; this is illustrated at Drużno Lake by *Cotylurus cornutus* and *Cyathocotyloides* sp., very many metacercariae of which were found in leeches and some molluscs (W i ś n i e w s k i), while their mature

forms were parasitic in *Aythya ferina*, a bird ranked with the species typical of the avifauna of Drużno, yet comparatively poorly represented.

Flukes of a wide specificity show a varying intensity of invasion of the final hosts at Drużno, viz., bird species may be distinguished in which the intensity of occurrence of the corresponding fluke spe-

Table XII
Occurrence of typical fluke species in hosts

Fluke species	*Anas crecca*	*Anas platyrhynchos*	*Anas strepera*	*Anas querquedula*	*Aythya ferina*	*Aythya fuligula*	*Aythya nyroca*	*Mergus albellus*	*Podiceps cristatus*	*Podiceps griseigena*	*Larus canus*	*Larus ridibundus*	*Ardea cinerea*
Echinochasmus coaxatus									56/19	100/5			
Echinoparyphium recurvatum		8/59					18/468						
Echinostoma revolutum		19/3			25/15	100*/5	5/1						
Hypoderaeum conoideum		46/11			25/11		5/40						
Monilifer spinulosus									31/99	100*/23			
Apatemon gracilis			100/44				5/25	75/126					
Diplostomum spathaceum											33/32	63/143	
Apophallus mühlingi											33/72	50/99	
Notocotylus attenuatus	33/1	34/30			25/1		5/1						
Typhlocoelum cucumerinum						50*/1	20/1,2						
Bilharziella polonica	33/10	52/19		75/5	75/12		41/7		8/1	100*/7			33/1

In numerator — percentage of invasion, in denominator — invasion index.
* Cases not covered by the analysis, as only one or very few specimens were examined.

cies is high and others in which the intensity of occurrence of the same fluke species is lower. Hosts in which the intensity of occurrence is high may be described as main, while hosts invaded less frequently and by a smaller number of flukes should be regarded as auxiliary.

The presence and number of final hosts, main and auxiliary, of fluke species of a wide specificity is another factor influencing the occurrence of fluke species in a given biocoenosis. If, then, there are more main hosts in the biocoenosis, the given fluke species may develop more easily, and if only auxiliary hosts occur, the possibilities of this species to develop are limited. Still, auxiliary hosts in a given biocoenosis are of great importance to the occurrence of a given fluke species, viz., they replace main hosts if these are absent and thus they secure the maintenance of the species, or make it easier for the range of main hosts to be widened. *Typhlocoelum cucumerinum* illustrates this well at Drużno. The main host of this species is *Anas clypeata*. Although this duck is very scanty at Drużno, *Typhlocoelum cucumerinum* ranks with the fluke species typical of the biocoenosis of the lake, which is largely due to the presence of *Aythya nyroca* and *Aythya fuligula*, auxiliary hosts. Parasitizing first of all auxiliary hosts at Drużno also accounts for the partly low intensity of invasion alongside of the fairly high extensity of invasion (Tables X & XII).

In order to distinguish main and auxiliary hosts I took into account two criteria: the percentage of invasion of birds with various fluke species, and the invasion index, i. e., the ratio of the total number of the parasites of one species found in a given host species to the number of the hosts invaded. E. g., 179 *Echinoparyphium recurvatum* were found in three *Anas platyrhynchos*, and so the invasion index was 59 (179 : 3 = 59). As main hosts we accepted the bird species which showed the highest percentage and the highest index of invasion by a given fluke species.

It follows from Table XIII that the following are main and auxiliary hosts of the flukes regarded as typical of the biocoenosis of Drużno Lake and occurring in several bird species:

The distinction of the main hosts explains the heavy occurrence in the Drużno biocoenosis of *Diplostomum spathaceum, Apophallus mühlingi, Monilifer spinulosus, Echinochasmus coaxatus, Notocotylus attenuatus*, and *Bilharziella polonica*, for their main hosts are typical representatives of the Drużno avifauna.

Table XIII

Main and auxiliary hosts of flukes in Drużno Lake biocoenosis

Fluke species	Main host	Auxiliary host
Echinochasmus coaxatus	*Podiceps cristatus*	*Podiceps griseigena*
Echinoparyphium recurvatum	*Aythya nyroca*	*Anas platyrhynchos*
Echinostoma revolutum	*Aythya ferina* *Anas platyrhynchos*	*Aythya nyroca* *Aythya fuligula*
Hypoderaeum conoideum	*Anas platyrhynchos*	*Aythya ferina* *Aythya nyroca*
Monilifer spinulosus	*Podiceps cristatus*	*Podiceps griseigena*
Apatemon gracilis	*Anas strepera* *Mergus albellus*	*Aythya nyroca*
Diplostomum spathaceum	*Larus ridibundus*	*Larus canus*
Apophallus mühlingi	*Larus ridibundus*	*Larus canus*
Notocotylus attenuatus	*Anas platyrhynchos*	*Anas crecca* *Aythya ferina*
Typhlocoelum cucumerinum		*Aythya nyroca* *Aythya fuligula*
Bilharziella polonica	*Anas platyrhynchos* *Anas crecca* *Aythya nyroca* *Aythya ferina*	*Podiceps cristatus* *Podiceps griseigena* *Ardea cinerea*

The invasion of birds in relation to food

The quantity and quality of the food taken by the host are important factors determining the degree to which birds are invaded by flukes. The above observations coincide with the regularity observed by Dogiel and his fellow-workers: "invasion by parasites depends on the quality of food taken".

From this point of view the birds of the Drużno avifauna may be divided into two different biological groups with respect to their way of life and feeding.

I. The first group covers bird species of the family *Anatidae*. Their food consists mainly of molluscs, insects, and plants; moreover, in smaller quantities, they eat crustacean plankton, *Oligochaeta* and *Hirudinea*, benthonic animals, sometimes small fish, etc. The variety of food is a source of multiple invasion, since, as follows from

Table XIV *Anatidae* contained the greatest number of flukes (14). Dominant are those fluke species whose larval forms (metacercariae) occur in molluscs *(Echinostomatidae — Hypoderaeum conoideum, Echinostoma revolutum, Echinoparyphium recurvatum)*, or in leeches *(Strigeidae — Apatemon gracilis, Cotylurus cornutus)*, or on plants *(Notocotylidae — Notocotylus attenuatus)*. The invasion of *Anatidae* is very high (86%).

II. The second group consists of representatives of *Laridae, Ardeidae, Podicipedidae, Phalacrocoracidae, Accipitridae, Rallidae, Scolopacidae*, and *Hirundinidae*. This group may still be divided into subgroups:

a. To this subgroup we have assigned: *Laridae, Podicipedidae, Ardeidae*, and *Phalacrocorax carbo*, the only representative of *Phalacrocoracidae*. Their food consists mainly of fish, also frogs and molluscs, and, in spring, insects (*Ardea cinerea*) as well. The quality of food clearly influences the fluke fauna, the latter consisting mainly of representatives of *Strigeidae* (metacercariae of *Tylodelphys conifera* and *Diplostomum spathaceum* live in fish, metacercariae of *Codonocephalus urnigerus* live in frogs) and *Echinostomatidae*. The fluke fauna of this subgroup is poorer than the fluke fauna of *Anatidae*. Representatives of eight fluke families were found in *Anatidae*, while in the birds of this subgroup the representatives of five fluke families were discovered (Table XIV). The invasion amounted to 58%.

b. The second subgroup covers *Rallidae*. Their food differs largely from that of *Anatidae*, yet it consists mainly of plants and insects, which considerably lessens the possibility of invasion. The percentage of invasion is low (22%).

c. The third subgroup consists of *Accipitridae*, living on small birds, frogs, and fish. So their food is poorly differentiated, which in turn accounts for a poorer fluke fauna (only two fluke species were found of the family *Strigeidae* — Table XIV). The invasion amounted to 40%.

d. *Scolopacidae* make up the fourth subgroup. Their food consists mainly of plants, insects, and their larvae and so it is more varied than that of *Carnivora*. Hence also more fluke species (4 fluke species of three families were found — Table XIV). The invasion is low and does not exceed 18%.

e. Finally, the fith subgroup consists of *Passeriformes* (Table XIV, see *Hirundinidae*), living on grain, fruit, terrestrial insects.

Table XIV

Invasion of birds in relation to food

Group		Bird family	Percentage of invasion	Number of fluke species	Number of specimens	Food	Number of species of various fluke families										
							Strigeidae	*Echinostomatidae*	*Plagiorchiidae*	*Cyclocoelidae*	*Eucotylidae*	*Notocotylidae*	*Schistosomatidae*	*Heterophyidae*	*Prosthogonimidae*	*Psilostomatidae*	*Brachylaemidae*
I		*Anatidae*	85	14	3812	molluscs, plants, insects, frogs, worms, small fish	4	3		2	1	1	1		1	1	
II	a	*Laridae*	50	7	5578	fish, water invertebrates, insects	2	1	2		1			1			
		Podicipedidae	76	4	954	fish, molluscs, frogs insects	1	2					1				
		Ardeidae	67	6	43	fish, amphibians, reptiles, molluscs, insects	4	1					1				
		Phalacrocoracidae	100	1	17	fish, small invertebrates		1									
	b	*Rallidae*	22	6	150	invertebr., water plants, molluscs, other insects		2		2		1	1				
	c	*Accipitridae*	40	2	10	mainly vertebrates	2										
	d	*Scolopacidae*	18	4	77	vegetable parts, small invertebrates		2	1								1
	e	*Hirundinidae*	9	1	23	insects			1								
						Total	13	12	4	4	2	2	4	1	1	1	1

Of the 23 birds examined which belonged to 12 species only two *Hirundo rustica* specimens were invaded by one fluke species.

Of the above mentioned groups those with more varied food show a higher invasion, while a lower invasion is evinced by groups feeding on more monotonous food.

By and large this bears out D o g i e l's statement on the relation between the quality of the food taken and the invasion by parasites, and it may be added that this relation is a ratio in a direct proportion. The more varied the food of the host, the more likely it is to become invaded by various fluke species, and vice versa.

Eutrophised Drużno Lake offers to *Anatidae* first of all favourable living conditions helping intensive and extensive invasion by flukes.

Seasonality of occurrence

As the research was carried on during three seasons of the year (spring, summer, and autumn) for two years the question may be answered in what degree fluke species in birds depend on various seasons of the year. The species which were most numerous and regarded as typical of the biocoenosis of Drużno Lake did not show seasonality in occurrence and maturation. Limitations in seasonal occurrence concern only species regarded as non-typical of the Drużno biocoenosis, yet this cannot be definitely verified, since too few hosts of these species were examined. The fact that no season of the year limits the occurrence or the degree of maturity of species typical of the biocoenosis essentially influences the number of these species. As they may occur and, above all, mature in various seasons of the year, they may multiply in the biocoenosis fairly freely. Lack of seasonality in maturation may therefore be regarded as one of the factors raising the intensity of occurrence of various fluke species.

Results and conclusions

Research on the parasitofauna of birds of Drużno Lake were carried on in 1950, 1951 and 1953. A total of 285 birds of ten families and 45 species were examined in 1950 and 1951, of which 143 (50%) were invaded by flukes. A high percentage of invasion was observed in *Anatidae, Podicipedidae,* and *Laridae.*

Most fluke species were found in *Aythya nyroca* (Linn.), *Anas platyrhynchos* (Linn.), *Aythya ferina* (Linn.), and *Larus ridibundus* (Linn.); most specimens of various fluke species were found in *Larus ridibundus* (Linn.), *Aythya nyroca* (Linn.), *Anas platyrhynchos* (Linn.), and *Podiceps cristatus* (Linn.).

A total of 43 fluke species of 11 families were found. This qualitatively rich quantity of fluke species is accompanied by an uneven occurrence of specimens of various species, i. e., some species are represented by hundreds or even thousands, others by a few specimens only. *Strigeidae* and *Echinostomatidae* dominate qualitatively and quantitatively in the Drużno biocoenosis.

Of the 43 fluke species 14 were denoted as typical, and 29 as non-typical, of the Drużno biocoenosis. The reasons which account for varying possibilities of various fluke species in Drużno Lake depend, according to my findings, on the following factors: specificity, quality of food, maturation in various seasons of the year.

What accounts for the heavy occurrence of flukes species in the biocoenosis of the lake is a wide specificity of a given fluke species, a great number of main hosts, varied food of hosts, and lack of seasonality in the occurrence and maturation of representatives of various fluke species. On the other hand, a narrow specificity, a small number or lack of main hosts, and little varied food, all restrain the occurrence of flukes.

The above factors largely account for various possibilities of development of various fluke species in the biocoenosis of Drużno Lake. That is why of the 43 fluke species found in birds only 14 could occur in larger quantities.

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LITERATURE

1. Beaver P. — Experimental Studies on *Echinostoma revolutum*. Univ. of Ill. Bull., 34, 74, 1937.
2. Beaver P. — Experiments of regeneration in the Trematode — *Echinostoma revolutum*. Journ. Parasit., 23, 4, 1937.
3. Baszkirowa E. — Echinostomatidy ptic SSSR i obzor ciklow ich razwitija. Tr. Baszk. Nauczn.-issl. Wet. St., 3, 1941.
4. Bittner H. — Parasitologische Beobachtungen. 2. *H. conoideum* gelegentlicher Darmparasit der Haustaube. Ztschr. Infektionskrankh. u. Hyg. d. Haust., 30, 3—4, 1927.
5. Bychowskaja-Pawlowskaja I. — Izmiencziwost' morfologiczeskich priznakow i znaczenije jejo w sistiematikie sosalszczikow siem. *Cyclocoelidae*. Parazit. Sbornik Zool. Inst. AN SSSR, 11, 1949.
6. Bychowskaja-Pawlowskaja I. — Izmiencziwost' morfologiczeskich priznakow i znaczenije jejo w sistiematikie sosalszczikow roda *Leucochloridium* Carus, 1835. Parazit. Sbornik Zool. Inst. AN SSSR, 13, 1951.
7. Bychowskaja-Pawlowskaja I. — Fauna sosalszczikow ptic Zapadnoj Sibiri i jejo dinamika. Parazit. Sbornik Zool. Inst. AN SSSR, 15, 1953.
8. Bychowskaja-Pawlowskaja I. — Sosalszcziki ptic Tadżikistana. Trudy Zool. Inst. AN SSSR, 21, 1955.
9. Daves B. — The *Trematoda*. Cambridge, 1946.
10. Dietz E. — Die Echinostomiden der Vögel. Zool. Jahrb. Suppl. 12, 1910.
11. Dogiel W. — Kurs obszczej parazitologii. Moskwa, 1947.
12. Dubinina M. — Parazitologiczeskoje issledowanije ptic. Zool. Inst. AN SSSR, 2, 1955.
13. Dubinina M. — Biologiczeskije adaptacji liczinocznych stadii i partenit sosalszczikow k otiskaniju i zarażeniju żywotnych choziajew. Wiestn. Leningr. Uniwer., 3, 1956.
14. Dubois G. — Monographie des *Strigeida (Trematoda)*. Mem. de la Soc. Neuchatel. des Sci. Nat., 6, 1938.
15. Edwards E. — On the anatomy of the Trematode *Paryphostomum radiatum* Dietz, 1909. Parasitology, 19, 1927.
16. Ginecinskaja T. — Nowyje dannyje o ciklach razwitija niekotorych trematod ptic. Dokłady AN SSSR, 66, 1949.
17. Ginecinskaja T. — Parazitofauna utinych ptic delty Wołgi. Ucz. Zap. LGU, ser. biol., 19, 1949.
18. Ginecinskaja T. — Parazity pastuszkowych ptic i poganok Astrachanskogo Zapowiednika. Trudy Len. Obszcz. Jestiestwoisp., 71, 4, 1952.
19. Harrah E. — North American Monostomes. Ill. Biol. Mon., 7, 3, 1922.
20. Johnson J. — The life cycle of *Echinostoma revolutum*. Univ. Calif. Publ. Zool., 19, 11, 1920.
21. Kotlan A. — Beiträge zur Kenntnis der Trematoden. Zool. Jahrb. Abt. Syst., 45, 1922.

22. Kossack W. — Über Monostomiden. Zool. Jahrb. Abt. Syst., 31, 1911.
23. Kozicka J. — Choroby ryb jeziora Drużno [Parazytofauna biocenozy jeziora Drużno — część VIII]. Acta Parasit. Polon., VI, 20, 1958.
24. Lühe M. — Die Süsswasserfauna Deutschlands. *Trematodes*. H. 17, 1909.
25. Mathias P. — Recherches experimentales sur le cycle evolutif de quelques *Trematodes*. Bull. Biol. France et Belge, 59, 1925.
26. Mc Leod J. — Two New Species of Schistosomatid *Trematodes* from Water Birds. Journ. Parasit., 23, 5, 1937.
27. Monticelli F. — Studii sui Trematodi endoparassiti. Zool. Jahrb. Suppl. 1—3, 1893.
28. Mühling P. — Die Helminthenfauna der Wirbeltiere Ostpreussens. Arch. Naturg., 64, 1, Berlin, 1898.
29. Nicoll W. — Complete reference list of *Trematodes* of British birds. Parasitology, 15, 1923.
30. Noble A. — Two new *Trematodes* from the American coot. Trans. Amer. Micr. Soc., 52, 1933.
31. Odhner T. — Zum natürlichen System der digenen Trematoden. Zool. Anz., 42, 7, 1913.
32. Skrjabin K. — K charaktieristikie gielmintofauny domasznich żywotnych Turkiestana. Zool. Jahrb. Abt. Syst., 35, 1913.
33. Skrjabin K. — Trematody żywotnych i czełowieka. AN SSSR, I—VIII, 1947—1953.
34. Tabangui M. — Observations of the life histories of *E. murinum* Tabangui, 1931 and *E. revolutum* Fröl., 1802. Philipp. Journ. Sc., 47, 3, 1932.
35. Witemberg G. — Trematody siem. *Cyclocoelidae* i nowyj princip ich sistiematiki. Izd. Gos. Inst. Eksp. Wet., 1, 1923.
36. Wiśniewski W. — Zagadnienia biocenologiczne w parazytologii. Wiad. Parazytol., I, 1, 1955.
37. Wiśniewski W. — Characterization of the parasitofauna of an eutrophic lake [Parasitofauna of the biocoenosis of Drużno Lake — part 1]. Acta Parasit. Polon., VI, 1, 1958.
38. Yamaguti S. — Studies on the Helminth Fauna of Japan. Jap. Journ. Zool., 8, 2, 25, 1939.

STRESZCZENIE

W latach 1950 i 1951 badano parazytocenozę jeziora Drużno. Przedmiotem moich badań były przywry ptaków. Ogółem zbadano 285 ptaków należących do 45 gatunków (Tab. I). Zarażonych przywrami było 50% ptaków.

Dużą ekstensywność zarażenia stwierdzono u *Anatidae, Laridae, Podicipedidae* i *Ardeidae,* mniejszą u *Rallidae, Scolopacidae, Phalacrocoracidae* i *Accipitridae.* Największą intensywność zarażenia stwierdzono u *Laridae* i *Anatidae.*

Z żywicieli największą ekstensywność zarażenia stwierdzono u *Anas platyrhynchos* (96%), a największą intensywność u *Larus ridibundus* (5441 osobników przywr). Najwięcej gatunków przywr znaleziono u *Aythya nyroca* (9 gat.), *Anas platyrhynchos* (8 gat.), *Aythya ferina* (6 gat.). Bardzo liczna na Drużnie *Fulica atra* ma ubogą faunę przywr.

U 25 gatunków ptaków znaleziono 43 gatunki przywr należące do 11 rodzin (Tab. II i III). Licznie reprezentowane są *Strigeidae* i *Echinostomatidae* (Tab. III).

W czasie badań stwierdzono, że intensywność i ekstensywność występowania poszczególnych gatunków przywr jest bardzo różna. Gatunki występujące u wielu ptaków oraz reprezentowane przez dużą liczbę osobników określono jako typowe dla biocenozy Drużna. Gatunki występujące u nielicznych ptaków i w małej liczbie określono jako gatunki nietypowe dla biocenozy Drużna. Ogólnie określono 14 gatunków jako typowe (Tab. X) i 29 gatunków jako nietypowe (Tab. XI).

Zauważono, że na zarażenie ptaków w biocenozie Drużna wpływa: stopień specyficzności gatunku przywry, jakość i ilość pokarmu dostępna dla żywiciela, pora roku, w której ptak się zaraża.

Z 43 gatunków przywr — 31 gatunków pasożytuje tylko u jednego gatunku ptaka a 12 gatunków pasożytuje u kilku gatunków ptaków (Tab. X i XI). Przywry o szerokiej specyficzności wykazują różną intensywność zarażenia ptaków - żywicieli ostatecznych. Żywicieli, u których intensywność występowania jest duża, określono jako głównych, żywicieli zarażonych rzadziej i mniejszą liczbą przywr — jako pomocniczych (Tab. XII i XIII). Stwierdzono, że im

bardziej urozmaicony pokarm spożywa żywiciel, tym większe ma szanse zarażenia się różnymi gatunkami przywr i odwrotnie (Tab. XIV).

Stwierdzono, że gatunki przywr typowe dla biocenozy Drużna nie wykazują sezonowości w występowaniu i dojrzewaniu.

Z przeprowadzonych badań wynika, że na masowe występowanie określonego gatunku przywry w danej biocenozie wpływa: szeroka specyficzność danego gatunku przywry, duża ilość żywicieli głównych, urozmaicony pokarm żywicieli i brak sezonowości w występowaniu i dojrzewaniu przedstawicieli tych gatunków.